TITLE OF THE INVENTION

MULTICHANNEL SIMULTANEOUS REALTIME SPECTRUM ANALYSIS WITH OFFSET FREQUENCY TRIGGER

BACKGROUND OF THE INVENTION

The present invention relates to spectrum analysis, and more particularly to an instrumentation receiver for multichannel simultaneous realtime spectrum analysis with an offset frequency trigger to allow new measurements and new views of signals in the frequency domain.

Realtime spectrum analyzers, such as the Tektronix WCA300 and WCA200 instruments, offer the ability to trigger a spectrum acquisition based on the occurrence of an event in the frequency domain. See U.S. Patent No. 5,103,402 together with Fig. 1 herein. Providing this frequency triggering function for a wideband intermediate frequency (IF) channel presents problems with implementation. The IF signal is digitized, windowed and transformed into the frequency domain typically by a fast Fourier transform (FFT). The resulting frequency domain data is compared in a frequency domain comparator stage with a user defined frequency domain mask to produce a trigger for a receiver acquisition system. The usefulness of the trigger function is based on its ability to trigger in real time. With the wideband IF channel being sampled at a very high rate, only a custom application specific integrated circuit (ASIC) would be able to provide the speed needed to perform the realtime triggering function for the wideband IF channel. Also since the wideband IF channel has reduced resolution, i.e., the number of bits provided by the analog-to-digital conversion (ADC) function,

the amount of dynamic range for the frequency trigger function is limited. For some users high dynamic range is an important part of the frequency triggering function.

What is desired is a realtime instrumentation receiver that performs a triggering function on a spectral event in real time while providing high dynamic range.

BRIEF SUMMARY OF THE INVENTION

Accordingly the present invention provides multichannel simultaneous realtime spectrum analysis with offset frequency trigger that inputs a wideband IF signal derived from a wideband RF signal by an instrumentation receiver to both a wideband IF channel and a narrowband IF channel simultaneously. The wideband IF signal output from the wideband IF channel is sampled at a high sample rate with relatively low resolution to produce wideband signal data. The wideband IF signal input to the narrowband IF channel is frequency offset by a variable amount according to a region in the wideband IF signal where a frequency trigger event is expected, and then narrowband filtered to produce a narrowband IF signal. The narrowband IF signal is sampled at a relatively low sample rate with high resolution to produce high dynamic range signal data for input to a frequency trigger function.

The objects, advantages and other novel features of the present invention are apparent from the following detailed description when read in conjunction with the appended claims and attached drawing.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

Fig. 1 is a block diagram view of a prior art frequency trigger function.

Fig. 2 is a block diagram view of an instrumentation receiver for multichannel simultaneous realtime spectrum analysis with offset frequency trigger according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to Fig. 2 a wideband intermediate frequency (IF) channel representing a wideband RF signal input to an instrumentation receiver is input to two IF channels **12, 14** simultaneously via a signal splitter **16**, each IF channel having different properties. One channel **12** is a wideband channel with a very wide bandwidth that is sampled with a very fast analog-to-digital converter (ADC) **18**. The other channel **14** is a narrowband channel with a narrower bandwidth that is sampled at a slower rate with a higher dynamic range ADC **20**. The narrowband channel **14** includes a frequency offsetting conversion stage **22** in order to move the sampled acquisition anywhere within the spectrum of the wide bandwidth channel **12**.

The IF signal of the wideband IF channel is derived from a common receiver (not shown) that samples a wideband input spectrum, as is common in the art. The IF signal is split by the splitter **16** into the two IF channels **12, 14**. The wide bandwidth channel **12** passes the IF signal through a bandpass filter **24** that acts as an anti-aliasing filter and samples the IF signal directly with the fast ADC **18** at a relatively low resolution, the fast ADC having a typical sample rate between several hundred megahertz up to a few

gigahertz. The narrowband channel **14** uses one or more conversion stages **22, 26** to accomplish the function of offsetting the IF signal by a variable amount and placing a narrow bandpass filter **28** on the offset subsection of the wideband spectrum. The narrow subsection of the wideband spectrum is then sampled at a lower rate, such as approximately 100 MHz, with the higher resolution ADC **20**. Both of the ADCs **18, 20** are locked to a common reference frequency.

The narrowband IF channel **14** provides the frequency trigger capability, while the wideband IF channel **12** provides for wideband signal acquisition. A user places the narrowband filter **28** across the band of frequencies where a frequency domain event is expected to occur. The narrowband IF data from the high resolution ADC **20** is passed through a frequency trigger module, such as that shown in Fig. 1, which may be implemented with off-the-shelf field programmable gate arrays (FPGAs) due to the slower sampling rate. Also the higher resolution ADC **20** provides additional resolution (more bits) so the dynamic range available to the frequency trigger function is increased over that available from the wideband IF channel **12**.

Thus the present invention provides an instrumentation receiver for multichannel simultaneous realtime spectrum analysis with an offset frequency trigger by routing a wideband IF signal acquired by the receiver from a wideband RF signal through two IF channels, a wideband channel and a narrow band channel, the wideband channel being sampled by a high speed, low resolution ADC, the narrowband channel being sampled by a

slower, high resolution ADC and the narrowband of the narrowband channel being variable via a frequency offset to cover any desired subsection of the wideband channel, the output from the narrowband channel being input to a frequency trigger function.

5